

HANCOCK-GREENFIELD BRIDGE

(County Bridge)

National Covered Bridges Recording Project

Spanning Contoocook River, Forest Road (formerly Old County
Road)

Hancock

Hillsborough County

New Hampshire

HAER NH-42

NH-42

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

U.S. Department of the Interior

1849 C Street NW

Washington, DC 20240-0001

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HANCOCK-GREENFIELD BRIDGE (County Bridge)

HAER No. NH-42

LOCATION: Spanning Contoocook River, Forest Road (formerly Old County Road),
Hancock, Hillsborough County, and Greenfield, Hillsborough County,
New Hampshire
UTM: 19.260603.4760190, Peterborough, New Hampshire Quad

STRUCTURAL
TYPE: Wood covered bridge; Teco truss

DATE OF
CONSTRUCTION: 1937

DESIGNER: Henry B. Pratt, Jr., New Hampshire Highway Department

BUILDER: Works Progress Administration

PRESENT OWNER: State of New Hampshire

PREVIOUS/
PRESENT USE: Vehicular Bridge

SIGNIFICANCE: Hancock-Greenfield Bridge was the first permanent highway span in the
northeastern United States to utilize timber connectors. It is one of seven
covered bridges built with timber connectors in the United States.

HISTORIAN: Researched and written by Lola Bennett, August 2003.

PROJECT
INFORMATION: The National Covered Bridges Recording Project is part of the Historic
American Engineering Record (HAER), a long-range program to
document historically significant engineering and industrial works in the
United States. HAER is administered by the Historic American Buildings
Survey/Historic American Engineering Record, a division of the National
Park Service, U.S. Department of the Interior. The Federal Highway
Administration funded the project.

Chronology

- 1791 First bridge built near this site
- 1805 America's first covered bridge built at Philadelphia
- 1810 Second bridge built near this site
- 1852 Third bridge built near this site
- 1920s Timber connectors developed in Germany
- 1933 Timber connectors introduced in United States
- 1936 Hancock-Greenfield Bridge damaged in flood
- 1937 Present Hancock-Greenfield Bridge constructed
- 1950 Teco truss revived in Massachusetts (Bissell Bridge, Charlemont)
- 1981 Hancock-Greenfield Bridge listed in the National Register
- 1981 Wood shingles replace asphalt roof shingles
- 2001 Henry B. Pratt, Jr. dies
- 2003 Hancock-Greenfield Bridge recorded by the Historic American Engineering Record

Description

The Hancock-Greenfield Bridge is a single-span covered timber Pratt truss bridge supported on concrete abutments. The total length of the bridge is 88', with a clear span of 84' between the bearing points. The bridge is 19'-4" between the centerlines of the top and bottom chords, and 24'-0" wide between the centerlines of the trusses, with a roadway width of 20'-0" between the wheel guards.

The bridge is framed as a modern Pratt truss, a form that was constantly modified throughout its life. Each truss has six panels, measuring 14'-0" long. The horizontal upper and lower chords are connected by vertical wood compression members and sloped wood endposts. The upper chords are paired 6"x12" timbers, stiffened at intervals by wooden spacer blocks. The lower chords are 4"x12" members, also stiffened with spacer blocks. Vertical timber posts, ranging in dimension from 8"x10" to 10"x12", connect the upper and lower chords. Truss diagonals are composed of paired members, ranging in dimension from 3"x12" to 6"x18", held apart and stiffened by wooden blocks or spacers placed at intervals along their lengths. Truss members are connected with bolted Timber Engineering Company (TECO) split-ring connectors or by TECO flanged shear plates. The upper chord connections at the two end panel points (U1 and U5) are connected by steel gusset plates and bolted 2 5/8" shear plates to establish wood-steel connections.

To accommodate wind loads, the bridge is heavily braced above and below with an unusual lateral bracing system. The upper lateral system is composed of a series of 3' deep tie beams, fabricated as trusses with split-ring connectors, spanning transversely between the vertical posts. The bottom chords of these upper lateral trusses are connected to the vertical posts by welded steel knee braces. The braces are fabricated with curved profiles and are covered with a casing of wooden sheathing. There is 3"x8" diagonal cross bracing between the upper chords within each panel. A steel rod attached to the ridgepole supports the midpoints of these diagonal members where they intersect along the centerline of the bridge. Triangular trusses that rise from the tip chord of each upper lateral tie beam support the gable roof. Diagonal struts rise from points 4' on each side of the centerline of the bridge to support a heavy timber ridgepole, while other diagonals support a purlin that runs longitudinally at the midpoint of each roof slope. The ridgepole and purlins, in turn, support a series of common rafters, placed about 1'-0" on center. Spruce sheathing covers the rafters. Wooden shingles replaced the original asphalt shingles in September 1981.

The floor system is composed of lateral trusses similar to the upper lateral bracing, which span between the vertical members where they are fastened with split ring connectors. These also serve as floor beams. There is 4"x8" lateral cross bracing placed diagonally between the lower chords along the length of the bridge. A series of 6"x16" stringers run longitudinally on top of the floor beams. The stringers support a deck composed of a solid membrane of laminated 6"x6" transverse timbers connected by toothed Teco rings. A treatment of chromated zinc chloride protects the laminated flooring. On top of the laminated membrane is a wearing surface originally composed of 1" thick asphalt block paving. The floor has since been covered with a pavement of asphalt-bound macadam. The lower chords of the trusses are seated on concrete

abutments. Portions of the old stone abutments are visible behind the concrete bridge seats. The bridge has a 4" positive camber at midspan.

Vertical flush boards of matched Douglas fir attached to horizontal nailers fastened to the outer faces of the trusses sheath the bridge. This sheathing extends inside the portals about 6' to form shelter panels around the ends of the trusses. Inside the bridge, the lower portions of the trusses are covered with a skirt of matched boarding. The portals are square with rounded upper corners.

New Hampshire Covered Bridges

The oldest documented covered bridge in New Hampshire is the Bath-Haverhill Bridge, built in 1829, and still spanning the Ammonoosuc River at Woodville.¹ At one time there were an estimated 300 covered bridges in the state.² This number gradually dwindled from the mid-nineteenth to the mid-twentieth century as fires, floods (in particular the disastrous flood of 1936), progress and vandalism destroyed bridges. In 1941, there were seventy-seven covered bridges remaining; by 1954 that number had dropped to fifty-seven.³ Since 1952, more have been lost, but at least a dozen modern covered bridges have been built, and—according to the National Society for the Preservation of Covered Bridges—the number of covered bridges in New Hampshire presently stands at sixty-two.⁴ These bridges range in age from 1829 to 2001, and represent nine different truss types.

The Hancock-Greenfield Bridge is unique among New Hampshire's covered bridges, because "although it was designed to resemble a nineteenth-century span, it introduced an advanced technology that greatly enhanced the usefulness of wood as a structural material in an age otherwise dominated by concrete and steel structures."⁵

History of Bridge and Site

County Road was laid out in the late eighteenth century as part of the overland route through Boston, Lowell, Nashua and Montpelier.⁶ There was a bridge near this location prior to 1797, when the Selectmen of Hancock were directed to "lay out a road through Captain Cummings' land from the County Road near the old bridge to where the new bridge is to be built, and offer

¹ See "Bath-Haverhill Bridge," HAER No. NH-33.

² Richard Sanders Allen, *Covered Bridges of the Northeast* (Brattleboro, Vermont: Stephen Greene Press, 1957), p.40. Allen states that there were "more than 200." More recent research by Richard Roy of the National Society for the Preservation of Covered Bridges has documented over 300.

³ Dan Ford, "Our Disappearing Covered Bridges," *New Hampshire Profiles*, November 1954, p.9.

⁴ National Society for the Preservation of Covered Bridges, *World Guide to Covered Bridges* database printout, April 2001.

⁵ Linda Ray Wilson and James L. Garvin, National Register of Historic Places Registration Form, "Hancock-Greenfield Bridge," Hillsborough County, New Hampshire, 2003, p.7.

⁶ Adolphus Darwin Tuttle, *A Prelude to Hancock's Second 100 Years: Recollections of Hancock's Earlier Years* (Hancock, New Hampshire, 1976), p.36.

him what they think right for said road.”⁷ However, the Town of Hancock could not agree with the Town of Greenfield over the best location for a bridge, so the matter remained unresolved until 1810, when a new bridge was built near this location. The third bridge at this site was built in 1852. It was a Long truss covered bridge, jointly funded by both towns, and built by Charles Gray of Hancock.⁸ That bridge stood until 1936, when disastrous spring floods destroyed hundreds of bridges all over New England.⁹ In the aftermath, Hancock-Greenfield Bridge was still standing, but, as the *Peterborough Transcript* reported, the “beloved landmark ... was damaged beyond repair.”¹⁰

Under provisions of the 1933 National Industrial Recovery Act and the 1934 Hayden Cartwright Act, extensive federal aid was available for replacing bridges destroyed by the flood. This work was supervised by state highway departments and overseen by the Bureau of Public Roads. In June 1936 the New Hampshire State Highway Department erected a temporary bridge about 50’ downstream from the old bridge and proposed to replace the former span with a reinforced concrete structure. Public opinion, however, opposed a “modern” structure and residents petitioned the state to rebuild the covered bridge.

With approval from the Bureau of Public Roads, highway department engineer Henry B. Pratt, Jr. designed a new type of covered bridge that would meet modern traffic requirements. The plans specified an 84’ timber Pratt truss on reinforced concrete abutments. It was 6’ wider and 6’ higher than its predecessor and used an estimated 3 tons of structural steel, in the form of timber connectors.¹¹ Timber connectors are metal rings that are embedded in adjacent members to transmit loads from one to the other. Because the connectors distribute stresses over a wide surface area, they enable the bridge to handle heavier loads than would be possible with pins or bolts.¹²

The Bureau of Public Roads approved the plans in November 1936, and a few weeks later the New Hampshire State Highway Department awarded the contract to the low bidder, Hagan Thibodeau Construction of Wolfeboro, for \$29,223.05.¹³ Construction began in April 1937, under the supervision of Willbert Gamache of Goffs Falls, and gained national attention three months later, when the following notice appeared in *Engineering News-Record*:

Plans are under way to replace an old covered timber bridge, using steel dowel connectors instead of wooden pegs or iron bolts at the joints, and a truss type whose stresses are determinable in contrast to those in the multiple intersection

⁷ William Willis Hayward, *History of Hancock, New Hampshire 1764-1889*, Volume I (Lowell: Vox Populi Press, 1889), p.271.

⁸ Ibid., p.81. There are field notes, sketches and photographs of this bridge in the National Society for the Preservation of Covered Bridges Archives at Westminster, Vermont.

⁹ Waldo G. Bowman, “Bridge Building Follows Flood,” *Engineering News-Record*, July 8, 1937, p.53.

¹⁰ *Peterborough Transcript*, March 26, 1936, p.2.

¹¹ Hancock History Committee, *The Second Hundred Years of Hancock, New Hampshire* (Canaan, New Hampshire: Phoenix Publishing, 1979), p.252.

¹² Wilson and Garvin, p. 3.

¹³ According to Richard Sanders Allen’s *Covered Bridges of the Northeast*, p. 47, the total cost of the bridge was \$77,000. Other sources give figures somewhere in between.

trusses of our forefathers. The bridge will cost as much as a steel or concrete bridge, but it is worth even more to the New Hampshire people who live near it.¹⁴

The bridge opened to traffic in October 1937, this time making front-page news in the *Peterborough Transcript*: “This type of bridge, popular a century ago, long since gave way to modern designs and sentiment played a major role in the erection of a new span. There are very few covered bridges left in New Hampshire and this is said to be the only new one of the type constructed in New England.”¹⁵

Timber Connectors

Timber connectors originated in Germany as an economic measure in the wake of World War I. They were adapted in America in the early 1930s, when the U.S. Forest Products Laboratory and U.S. Department of Commerce began studying their potential to decrease construction costs and increase the serviceability of wood as a building material.¹⁶ In 1933, the U.S. National Committee on Wood Utilization issued a report, *Modern Connectors for Timber Construction*, which stimulated interest in wood as a structural material.¹⁷ In 1934, the Timber Engineering Company (TECO), a subsidiary of the National Lumber Manufacturer's Association, acquired the patent rights to a number of timber connectors for the purpose of distributing them on a commercial basis. In 1935, TECO published the first *Manual of Timber Connector Construction* for engineers and contractors, which stated:

These improved connections enable a pound of good structural timber to do in general the same work that is to be expected from a pound of steel. The greatly increased strength secured at crucial points is of such prime engineering importance as frequently to change both the methods of design and cost aspects of many structural types. Timber can now be used economically for types of structures for which it has not formerly been considered, and timber structures can now be designed for wider spans and heavier loads than before.¹⁸

Although never popular for covered bridges, timber connectors were used for airplane hangers, radio towers and roofs. Hancock-Greenfield Bridge has the distinction of being one of the first permanent highway spans to use timber connectors.¹⁹ Today, there are seven covered bridges of this type in the United States.

Henry B. Pratt, Jr.²⁰

¹⁴ Another source says William Gamarsh. Waldo G. Bowman, “Bridgebuilding Down East,” *Engineering News-Record*, July 22, 1937, p.149.

¹⁵ “New Covered Bridge over Contoocook River,” *Peterborough Transcript*, October 14, 1937, p.1.

¹⁶ “Modern Connectors for Timber Joints,” *Scientific American* 149 (July 1933): p.36.

¹⁷ Wilson and Garvin, p. 3.

¹⁸ Timber Engineering Company, *Manual of Timber Connector Construction* (Washington, DC: Timber Engineering Company, 1935), p.1.

¹⁹ Wilson and Garvin, p. 4.

²⁰ Biographical sketch compiled from typed obituaries in New Hampshire Division of Historical Resources files.

Born at Waltham, Massachusetts in 1910, Henry Pratt moved with his family to Antrim, New Hampshire in 1922. He attended the Mt. Hermon School in Northfield, Massachusetts, and graduated from Worcester Polytechnic Institute with a degree in engineering in 1932. He subsequently worked for the Caughey & Pratt Construction Company in Antrim, the U.S. Geological Survey, and the New Hampshire Highway Department. At age 26, he was transferred into the Bridge Department, which was then facing the challenge of reconstructing bridges following the disastrous flood of 1936. Pratt designed three bridges during his tenure at the department, the first of which was the Hancock-Greenfield Bridge.

Following highway department layoffs, Pratt spent twenty years designing pulp and paper mills around the country. After working for some time in the Pacific Northwest, Pratt formed his own consulting partnership in Seattle. He retired from professional engineering in 1974, but continued to take occasional consulting assignments involving pulp mill process design. Henry Pratt died in October 2001.

Sources

Allen, Richard Sanders. *Covered Bridges of the Northeast*. Brattleboro, Vermont: Stephen Greene Press, 1957.

A Biographical Dictionary of American Civil Engineers, Volume I. New York: American Society of Civil Engineers, 1972.

Bowman, Waldo G. "Bridge Building Follows Flood." *Engineering News-Record*, July 22, 1937.

Bowman, Waldo G. "Bridge Building Down East." *Engineering News-Record*, July 22, 1937.

"Bridges of Today." *Engineering News-Record*, January 13, 1938.

"Connectors Cut Woodbuilding Cost." *Popular Science Monthly*, October 1933.

Hurd, D. Hamilton. *History of Hillsborough County, New Hampshire*. Philadelphia: J.W. Lewis & Co., 1885.

Hancock History Committee. *The Second Hundred Years of Hancock, New Hampshire*. Canaan, New Hampshire: Phoenix Publishing, 1979.

Town of Greenfield, New Hampshire. *Annual Reports*, 1937.

Hansen, Howard J. *Modern Timber Design*. New York: John Wiley and Sons, 1943.

Hayward, William Willis. *History of Hancock, New Hampshire 1764-1889*, Volume I. Lowell: Vox Populi Press, 1889.

"Modern Connectors for Timber Joints." *Scientific American* 149 (1933): p.36.

"New Covered Bridge over Contoocook River." *Peterborough Transcript*, October 14, 1937, p. 1.

Pratt, Henry B., Jr. and George W. Huntley. Construction Drawings, Hancock-Greenfield Bridge 15 sheets, 1936-37. Files of New Hampshire Department of Transportation.

Timber Engineering Company. *Manual of Timber Connector Construction*. Washington, DC: Timber Engineering Company, 1935.

"To Build Covered Bridge." *Peterborough Transcript*, December 3, 1936, p. 1.

Wilson, Linda Ray and James L. Garvin. National Register of Historic Places Registration Form, "Hancock-Greenfield Bridge," 2003.

Wilson, Ray. "The TECO Truss." *Covered Bridge Topics* 29 (January 1972): p.8.